Bull. Southern California Acad. Sci.
110(3), 2011, pp. 177–183

A New Species Of Late Cretaceous (Campanian) Cypraeid Gastropod, Santa Ana Mountains, Southern California and New Records of California Cretaceous Cypraeids

Lindsey T. Groves,[1] Harry F. Filkorn,[2] and John M. Alderson[3]

[1]*Natural History Museum of Los Angeles County, Malacology Section, 900 Exposition Boulevard, Los Angeles, CA 90007, lgroves@nhm.org*
[2]*Los Angeles Pierce College, Physics and Planetary Sciences Department, 6201 Winnetka Avenue, Woodland Hills, CA 91371, filkornh@piercecollege.edu*
[3]*Natural History Museum of Los Angeles County, Invertebrate Paleontology Section, 900 Exposition Boulevard, Los Angeles, CA 90007, jjalderson@live.com*

Abstract.—A new species of Cypraeidae is described from the middle Campanian (Late Cretaceous) portion of the Schulz Ranch Member of the Williams Formation, Santa Ana Mountains, Orange County, southern California. This is the first cypraeid described from the Williams Formation and only the second cypraeid species described from the Santa Ana Mountains. New paleogeographic and chronologic records of previously described and indeterminate Cretaceous cypraeid species are also listed.

Introduction

Cretaceous cypraeids are uncommon in North American strata and comprise 17 previously described species (Groves, 1990; 1994; 2004). Of these 17 species, seven are in the genus *Palaeocypraea*, four are in the genus *Bernaya s.s.*, and six are in the genus/subgenus *Bernaya (Protocypraea)*. A new species of *Bernaya (Protocypraea)* is described from the Upper Cretaceous (middle Campanian) Schulz Ranch Member of the Williams Formation, Santa Ana Mountains, Orange County, southern California. This is the first cypraeid species described from the Williams Formation, which brings the North American total to 18. Of these 18 species 12 are from western North America (Table 1).

Stratigraphy and Geologic Age

Popenoe (1937) informally introduced the Schulz member of the Williams Formation as part of a "generalized section of formations in the Santa Ana Mountains, California." The Schulz Member of the Williams Formation of Popenoe (1942) was formally described for outcrops of Late Cretaceous age approximately 0.402 km (0.25 mile) upstream from the mouth of Williams Canyon, near the western boundary of the Schulz Ranch, Santa Ana Mountains, Orange County, California. The member was composed predominantly of coarse-grained, light-colored, cross-bedded arkosic sandstone and minor boulder beds. To eliminate confusion with the Schulz Member of the Talpa Formation of Permian age in Coleman County, Texas, Woodring and Popenoe (1945) revised the name to the Schulz Ranch Member of the Williams Formation.

The new species was collected from a conglomeratic sandstone bed from the basal 4.5–6.0 m (15–20 ft.) of the Schulz Ranch Member above a disconformable contact with the

Table 1. Updated list of Cretaceous cypraeid species from North America and their generalized localities (formation is included for the new species).

PALAEOCYPRAEA
Early Cretaceous
Palaeocypraea fontana (Anderson, 1958) [Shasta Co. California]
Late Cretaceous
Palaeocypraea corsicana (Stephenson, 1948) [Navarro Co., Texas]
P. grooti (Richards and Shapiro, 1963) [New Castle Co., Delaware]
P. nuciformis (Stephenson, 1941) [Navarro Co., Texas]
P. squyeri (Campbell, 1893) [Dawson Co., Montana]
P. suciensis (Whiteaves, 1895) [San Juan Co., Washington]
P. wilfredi Groves, 2004 [Butte Co., California]
BERNAYA s.s* and *BERNAYA (PROTOCYPRAEA)
Late Cretaceous
Bernaya (Bernaya) beardi Groves, 2004 [Vancouver Id., British Columbia]
B. (B.) burlingtonensis (Schilder, 1932) [Burlington Co., New Jersey]
B. (B.) crawfordcatei Groves, 1990 [San Diego Co., California]
B. (B.) jeanae Groves, 2004 [Butte Co., California]
B. (Protocypraea) argonautica (Anderson, 1958) [Jackson Co., Oregon]
B. (P.) berryessae (Anderson, 1958) [Yolo Co., California]
B. (P.) gualalaensis (Anderson, 1958) [Mendocino Co, California]
B. (P.) louellasaulae new species [Williams Fm., Orange Co., California]
B. (P.) mississippiensis Groves, 1990 [Lee Co., Mississippi]
B. (P.) popenoei Groves, 2004 [Orange Co., California]
B. (P.) rineyi Groves, 1990 [San Diego Co., California]

underlying Holz Shale Member of the Ladd Formation. Filkorn (2005) reported the first occurrence of the hippuritid rudist bivalve *Barrettia sparcilirata* Whitfield, 1897 from the Upper Cretaceous of the North American west coast along with the more widely distributed caprinid rudist *Coralliochama orcutti* White, 1885, from the locality. He further reported in 2007 that the fauna also included fragments of an undetermined species of radiolitid rudist. Additional bivalve genera and species at the locality include *Calva*, *Crassatella*, *Cucullaea*, *Glycymerita veatchii* (Gabb, 1864), *Indogrammatodon*, *Opis rosarioensis* Anderson and Hanna, 1935, *Pterotrigonia*, and *Spondylus*. Gastropod genera and species include *Ampullina?*, *Bernaya* (*Protocypraea*) sp., cf. *B.* (*P.*) *popenoei* Groves, 2004, *Biplica*, *Pentzia*, *Volutoderma santana* Packard, 1922, and an undetermined cerithiid. One paratype of *Prisconatica hesperia* Squires and Saul, 2004, LACMIP 8128, is from LACMIP locality 27199, which is equivalent to the new cypraeid locality LACMIP 17761. It was thought that the specimen represents reworked material from the underlying upper part of the lower Campanian Holz Shale Member of the Ladd Formation (Squires and Saul, 2004). Non-molluscan biota includes several species of colonial scleractinian corals and the calcareous alga *Archaeolithothamnium* sp. Despite containing rip-up clasts from the underlying Holz Shale Member of the Ladd Formation, fossils in the conglomeratic sandstone were mostly unabraded and well-preserved with original shell material. This unabraded condition indicated that they were not reworked and likely only transported a short distance, possibly by a storm surge. Squires and Saul (2009) indicated the stratigraphical range of the bivalve *Opis rosarioensis* Anderson and Hanna, 1935, found here and elsewhere in the Schulz Ranch Member of the Williams Formation, to be lower middle Campanian.

Abbreviations

Abbreviations used for institutional specimen and locality numbers are: CAS, California Academy of Sciences, San Francisco; LACMIP, Natural History Museum of Los Angeles County, Invertebrate Paleontology Section; SC, Sierra College, Rocklin, California; SU, Stanford University, Palo Alto, California [collections now housed at CAS]; UCLA, University of California, Los Angeles [collections now housed at LACMIP].

Measurement parameters were defined as: length = greatest distance between anterior and posterior ends; width = greatest distance between lateral margins; and height = greatest distance between base and dorsum.

Systematic Paleontology

The classification used here follows that of Schilder and Schilder (1971).

Superfamily Cypraeoidea Rafinesque, 1815

Family Cypraeidae Rafinesque, 1815

Subfamily Bernayinae Schilder, 1927

Tribe Bernayini Schilder, 1927

Genus *Bernaya* Jousseaume, 1884

Type Species: *Cypraea media* Deshayes, 1835, by original designation. Upper middle Eocene (Bartonian Stage), Auvers-sur-Oise, Val-d'Oise (northwest of Paris), France.

Diagnosis: Shell small to large size; anterior end weakly carinate; dorsum smooth; spire of medium height and partially exposed; aperture wide, sides rounded; anterior and posterior canals deep; fossula smooth, concave, wide.

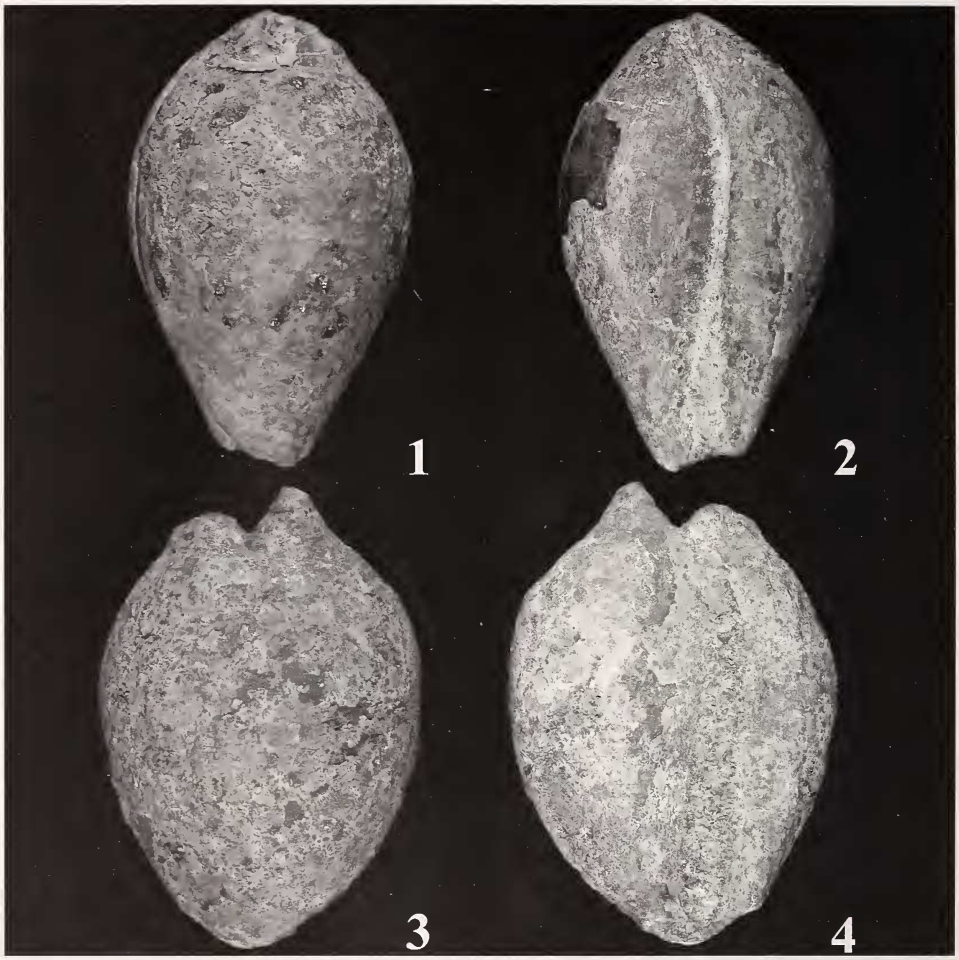
Remarks: Schilder and Schilder (1971) recognized five species and two subspecies of worldwide Cretaceous *Bernaya s. s.*, and all seven were recognized as full species by Groves (1994). Subsequent to Schilder and Schilder (1971), Yü and Zhu (1983) described a single new species, and Groves (1990, 2004) described three additional species. Although these studies raised the present total to 11 species, only three of the species are from western North America. Groves (2004) documented a poorly preserved specimen of *B. (B.) crawfordcatei* Groves, 1990, from the Campanian Pleasants Sandstone Member of the Williams Formation, the only known *Bernaya s. s.* from the Santa Ana Mountains.

Subgenus *Protocypraea* Schilder, 1927

Type Species: *Eocypraea orbignyana* Vredenburg, 1920, by original designation. Upper Cretaceous (Turonian through Santonian), Trichinopoly Group, Kullygoody, southern India.

Diagnosis: Shell small to large size; moderately pyriform shape, constricted anteriorly; fossula smooth, concave, wide.

Remarks: Schilder and Schilder (1971) recognized eight species and seven subspecies of Cretaceous *Bernaya (Protocypraea)* and all of their subspecies were elevated to specific level by Groves (1994). Subsequent to Schilder and Schilder (1971), three species were described by Groves (1990 and 2004), and another new species is described here. This raises the present total to 19 species, five of which are from western North America. Groves (2004) described *Bernaya (Protocypraea) popenoei* from the lower Campanian Holz Shale Member of the Ladd Formation, the only species of *Bernaya (Protocypraea)* previously known from the Santa Ana Mountains.



Explanation of Figures 1–4. Cretaceous cypraeids from the Santa Ana Mountains: Fig. 1 - *Bernaya* (*Protocypraea*) *louellasaulae* new species, holotype LACMIP 13720, from LACMIP loc. 17761, dorsal view (× 3.7). Fig. 2 – ventral view of same specimen. Fig. 3 - *Bernaya (Protocypraea)* sp., cf. *B. (P.) popenoei* Groves, 2004, hypotype LACMIP 13893, from LACMIP loc. 17761, dorsal view (× 3.6). Fig. 4 – ventral view of same specimen.

Bernaya (Protocypraea) louellasaulae new species

(Figs. 1–2)

Diagnosis: *Bernaya* of medium size, anterior and posterior canals deep, spire of medium height, fossula concave, and smooth posterior terminal ridges extend to margins.

Description: Shell of small to medium size, constricted anteriorly; maximum height of shell nearly centered; maximum width of shell slightly posterior of center; dentition coarse to medium with smooth interstices; columellar lip with 11 teeth, labral lip with 15 teeth; aperture fairly wide and straight, curved posteriorly toward columella, widens anteriorly; terminal canals deep; columella slightly inflated; prominent anterior terminal ridges form a slight marginal callus; posterior terminal ridge extended from base of spire to form a slight marginal callus; spire of medium height and partially exposed due to shell loss.

Comparison: The new species resembles *Bernaya (Protocypraea) veraghoorensis* (Stoliczka, 1867) from the Upper Cretaceous (Campanian) Arrialoor Group, near Veraghoor, Tamilnadu District, India, particularly the specimen figured by Stoliczka (1868: pl. 4, fig. 4) [as *Cypraea (Luponia) carnatica*]. In contrast, the new species is less inflated, more constricted anteriorly, and has a narrower and less sinuous aperture than *B.* (*P.*) *veraghoorensis*.

Discussion: Generic and subgeneric assignment are based on the wide aperture, deep anterior and posterior canals, and medium-height spire. *Bernaya (Protocypraea) louellasaulae* represents the first cypraeid described from the Williams Formation.

Type Material: Holotype, LACMIP 13720. A single fairly well-preserved specimen with minor amounts of apparent original shell material on the base and lateral margins. The specimen measures 17.2 mm in length, 10.8 mm in width, and 9.3 mm in height.

Type Locality: LACMIP loc. 17761, Schulz Ranch Member of Williams Formation, near 533 m (1750 ft.) elevation at bottom of eastern tributary to Fremont Canyon, Santa Ana Mountains, Orange County, California. Collectors: John M. Alderson and Harry F. Filkorn, 4 April, 2004.

Etymology: This species is named for LouElla R. Saul (LACMIP, Research Associate) for her numerous important contributions to the paleontology of the western United States.

Additional Records of California Cretaceous Cypraeids

Bernaya (Protocypraea) sp., cf. *B.* (*P.*) *popenoei* Groves, 2004

(Figs. 3–4)

New Record: Hypotype, LACMIP 13893, LACMIP loc. 17761 (see locality description above), Upper Cretaceous Schulz Ranch Member, Williams Formation, collected by John M. Alderson and Harry F. Filkorn, 4 April, 2004. This record is based on a single fairly well-preserved internal mold, that is 25.5 mm in length, 17.7 mm in width, and 13.2 mm in height.

Distribution: This species was formerly restricted to the lower Campanian part of the Holz Shale Member of the Ladd Formation and is here extended upward to the lower middle Campanian part of the Schulz Ranch Member of the Williams Formation.

Bernaya? sp.

New Record: SC MG153, Granite Bay, Treelake Village Estate, northeast of Sacramento, Placer County, California. Upper Cretaceous (Campanian), Chico Formation. Poorly preserved internal mold. Collected by Richard P. Hilton (SC) during paleontological monitoring for land development in 1999.

Cypraeidae, undetermined genus and species

New Record: CAS 69097.03 (*ex* SU 30286), Dip Creek, San Luis Obispo County, California. Uppermost Cretaceous/lowermost Paleocene Dip Creek Formation. A single poorly preserved internal mold. Collected by Nicolas L. Taliaferro, date unknown.

Acknowledgments

We thank Richard L. Squires (California State University, Northridge, Department of Geological Sciences) who critically reviewed an early draft of the manuscript and made helpful suggestions. LouElla R. Saul (LACMIP) generously assisted with the

identifications of specimens from LACMIP loc. 17761. Cathy L. Groves (LACM, Echinoderms Section) and Brian Koehler (formerly LACM, Entomology Section) are thanked for their input in composing the figures. The critiques of LouElla Saul (LACMIP) and Steffen Kiel (University of Göttingen, Paleobiology Group, Germany) are greatly appreciated.

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Appendix 1.

Localities Cited

CAS 69097. Dip Creek, NE ¼ sec. 30, T25N, R10E, U.S. Geological Survey Adelaida 7.5′quadrangle, San Luis Obispo Co., California. Uppermost Cretaceous/lowermost Paleocene, Dip Creek Formation (?). Collector: Nicolas L. Taliaferro, date unknown.

LACMIP loc. 17761. Float blocks of conglomeratic sandstone from basal 4.5–6.0 m (15–20 ft) of member, near 533 m (1750 ft.) elevation at bottom of eastern tributary to Fremont Canyon, center of SW ¼ SW¼ sec. 7, T4S, R7W, U.S. Geological Survey Black Star Canyon 7.5′quadrangle (1967 [PR 1973]), eastern Santa Ana Mountains, Orange County, California. Upper Cretaceous (lower middle Campanian), Schulz Ranch Member, Williams Formation. Collectors: John M. Alderson and Harry F. Filkorn, 4 April, 2004 and 4 April, 2005. This locality is equivalent to LACMIP loc. 27199 (= UCLA 7199) collected by Willis P. Popenoe and J.E. Schoellhammer in 1951.

SC MG153. Granite Bay, Treelake Village Estate, NE ¼ sec. 16, T10N, R7E, U.S. Geological Survey 7.5′ Folsom quadrangle (1967 [PR1975]), northeast of Sacramento, Placer Co., California. Upper Cretaceous (Campanian), Chico Formation. Collector: Richard P. Hilton, 1999.